US005752134A

United States Patent [19]

Hazama et al.

[11] Patent Number: 5,752,134

[45] Date of Patent: May 12, 1998

[54] **PROCESS UNIT OF IMAGE FORMING MACHINE HAVING PRE-TRANSFER GUIDE**

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[21] Appl. No.: **853,903**

[22] Filed: **May 9, 1997**

[30] **Foreign Application Priority Data**

May 31, 1996 [JP] Japan 8-137308

[51] **Int. Cl.**[6] **G03G 21/18**

[52] **U.S. Cl.** **399/113**; 399/316; 399/388

[58] **Field of Search** 399/111, 316, 399/317, 388, 113, 121, 124

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,101,212	7/1978	Sumiyoshi et al.	399/316
4,464,042	8/1984	Omori et al.	399/316
4,547,059	10/1985	Nagayama et al.	399/165
4,609,276	9/1986	Mitzutani	399/111
4,809,033	2/1989	Ikemoto et al.	399/111
4,873,548	10/1989	Kobayashi et al.	399/111
4,882,606	11/1989	Deguchi	399/316
5,055,876	10/1991	Matsuoka et al.	399/111
5,095,334	3/1992	Nukaya	399/111
5,594,539	1/1997	Murano et al.	399/316

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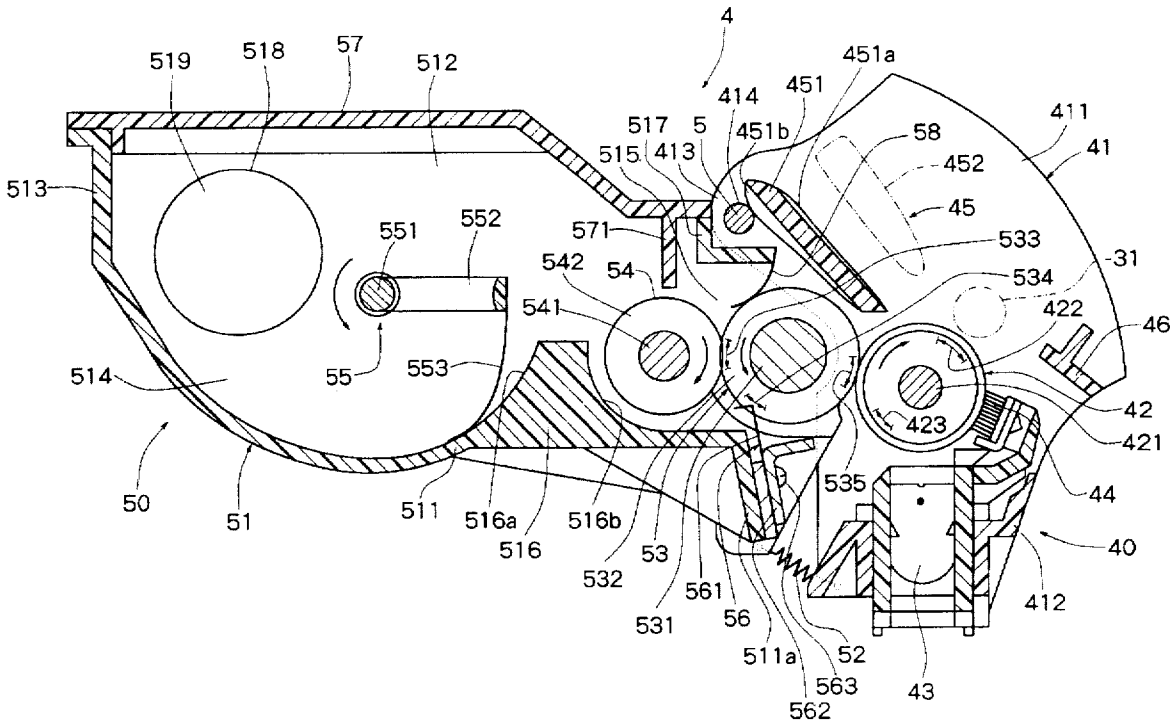
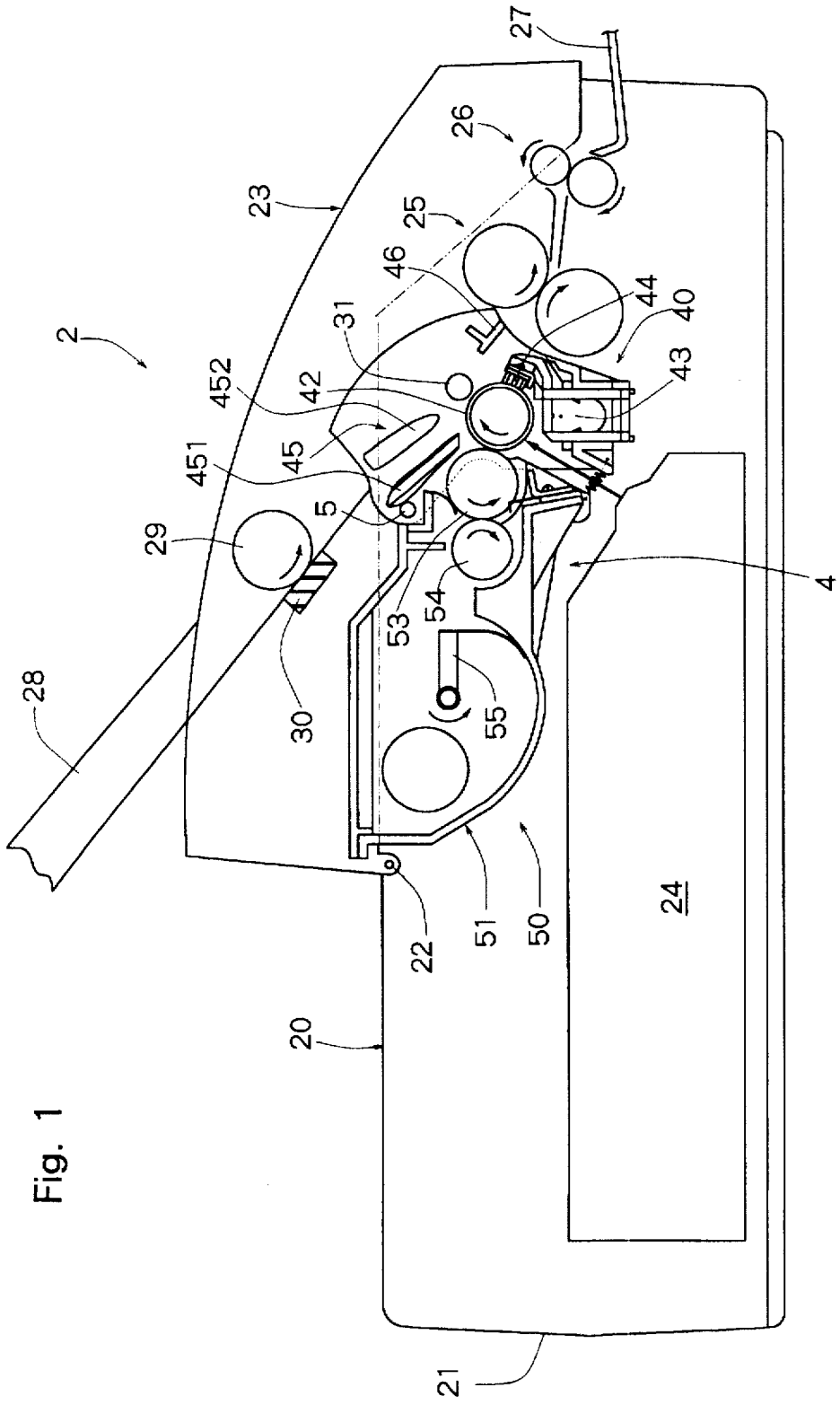
[57] **ABSTRACT**

A process unit of an image forming machine, comprising a photoconductor unit including a photoconductor drum, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image, the photoconductor unit and the developing unit being connected by a support shaft so as to be pivotable relative to each other; in which a pre-transfer guide plate for guiding a transfer sheet to be conveyed to a transfer zone is disposed on a photoconductor support means for supporting the photoconductor drum rotatably, and the rear surface of the pre-transfer guide plate is brought into contact with the support shaft or a development housing.

5 Claims, 4 Drawing Sheets

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451
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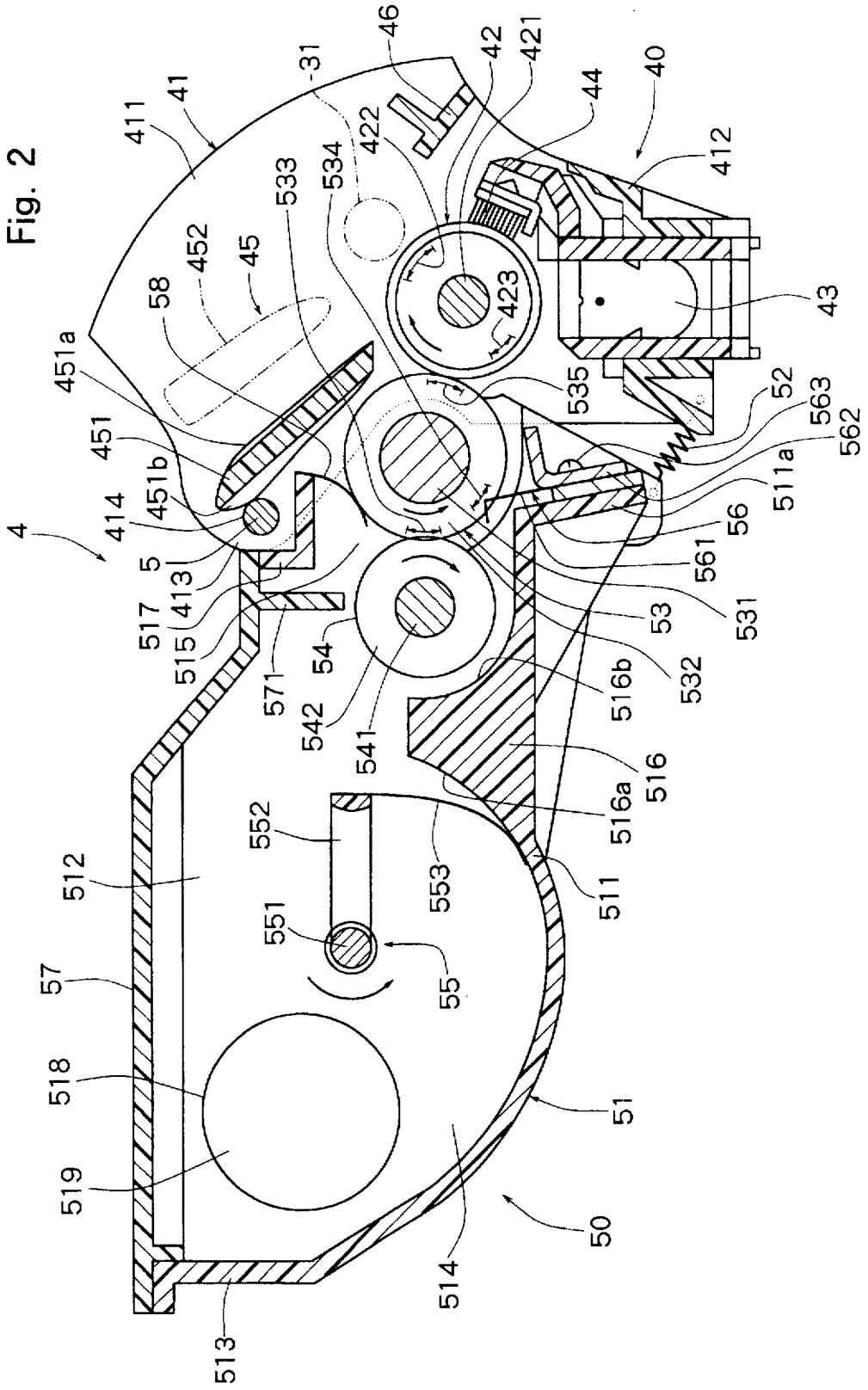
24
22
51
50
20
21

Fig. 1

Fig. 2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513

Fig. 3

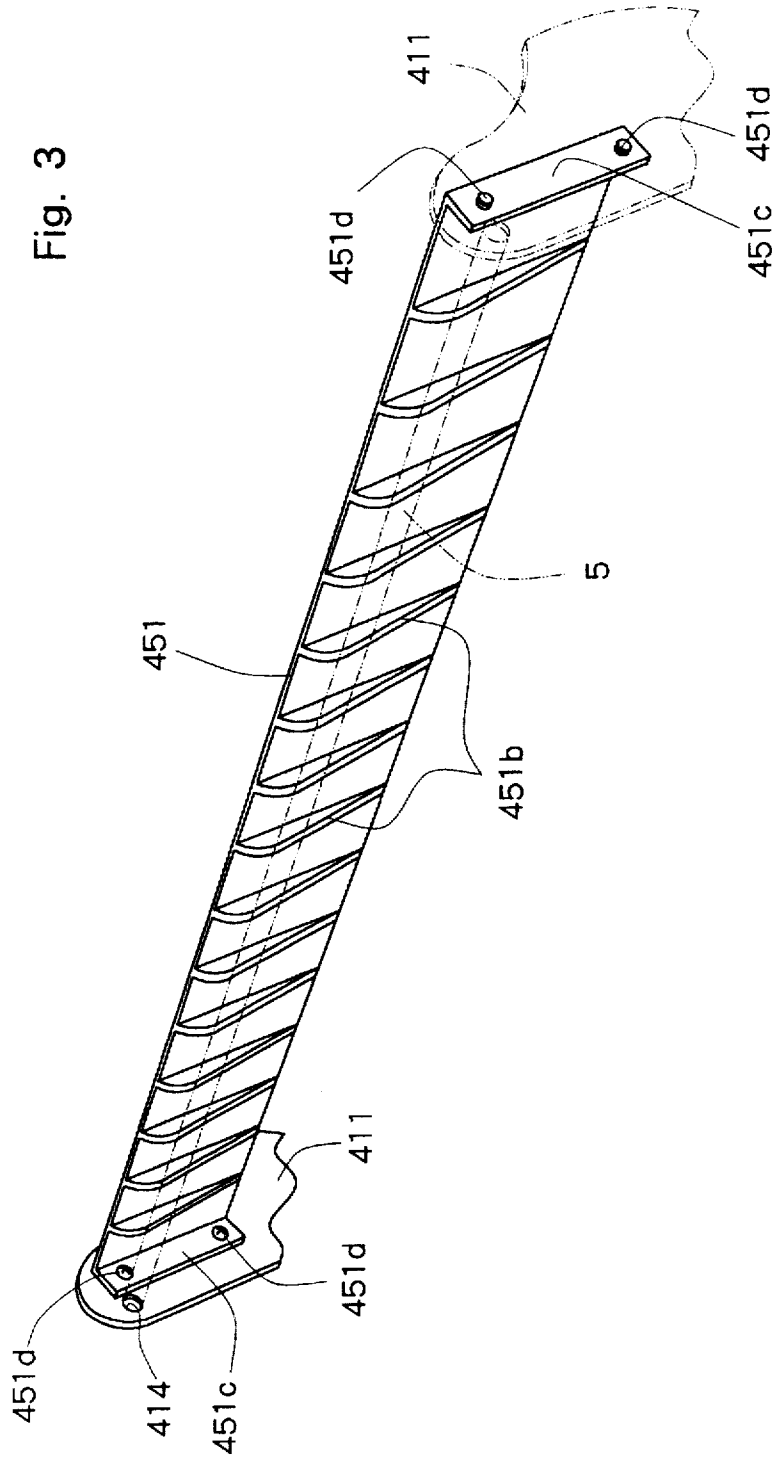
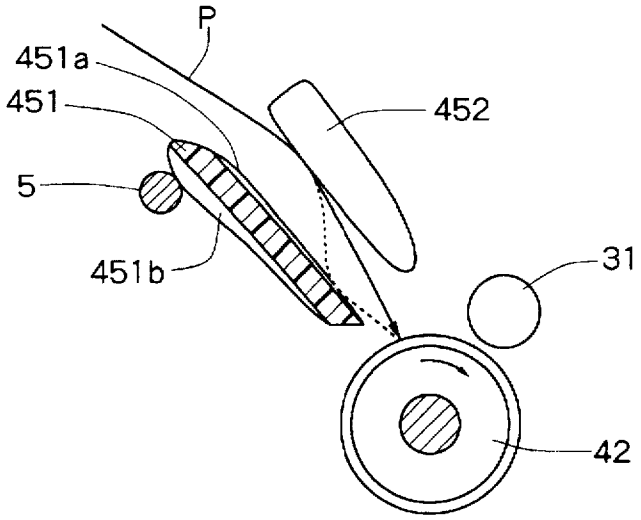


Fig. 4


P
451a
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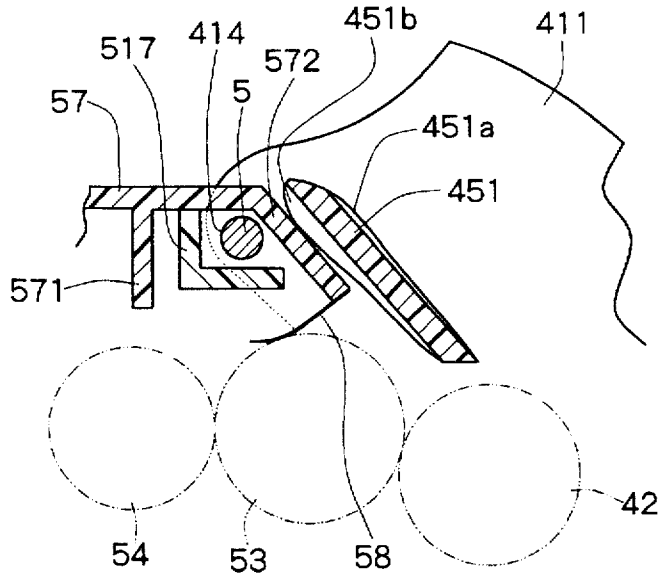
452
5
31
451b
42

Fig. 5


517
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PROCESS UNIT OF IMAGE FORMING MACHINE HAVING PRE-TRANSFER GUIDE

FIELD OF THE INVENTION

The present invention relates to a process unit for forming a toner image on a photosensitive layer of a photoconductor drum in an image forming machine such as an electrostatic copier or a laser printer.

DESCRIPTION OF THE PRIOR ART

In recent years, wide use has been made of an image forming machine in which a photoconductor drum having a photosensitive layer, and a developing device for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum are mounted on a frame to serve integrally as a process unit, and this process unit is mounted detachably in a machine housing.

To a transfer zone of the photoconductor drum in the process unit, a sheet of transfer paper (transfer sheet) for bearing a toner image, formed on the photoconductor drum, upon transfer needs to be conveyed.

In the machine housing where the process unit is mounted, a guide plate for guiding the transfer sheet to the transfer zone is disposed. This guide plate should be always kept in a highly accurate positional relationship with the photoconductor drum in order to guide the transfer sheet to a proper position in the transfer zone. When a transfer sheet with a large thickness and a high stiffness, such as a postcard, is used, the front end of the transfer sheet is guided by the guide plate and contacted with the photoconductor drum. Then, its front end portion is bent, and this bend presses the guide plate strongly. Its pressing force deflects the guide plate, causing a deviation in its positional relationship with the photoconductor drum, thus posing the problem that the guide plate cannot guide a transfer sheet to the proper position in the transfer zone.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide a process unit of an image forming machine, which the process unit can prevent the deflection of a guide plate for guiding a transfer sheet to a transfer zone even when a pressing force of the transfer sheet acts on the guide plate, thus keeping the positional relationship between the guide plate and the photoconductor drum always highly precise.

To attain this principal object, the present invention provides a process unit of an image forming machine, the process unit comprising a photoconductor unit including a photoconductor drum having a photosensitive layer, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image, the photoconductor unit and the developing unit being connected by a support shaft so as to be pivotable relative to each other, and the process unit being adapted to transfer the toner image to a transfer sheet conveyed to a transfer zone of the photoconductor drum; wherein

the photoconductor unit includes a photoconductor support means for supporting the photoconductor drum rotatably,

a pre-transfer guide plate for guiding a transfer sheet to be conveyed to the transfer zone is disposed on the photoconductor support means, and

when a pressing force by a transfer sheet is exerted at least during the guidance of the transfer sheet, the rear surface of the pre-transfer guide plate is brought into contact with the support shaft.

The present invention also provides a process unit of an image forming machine, the process unit comprising a photoconductor unit including a photoconductor drum having a photosensitive layer, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image, and the process unit being adapted to transfer the toner image to a transfer sheet conveyed to a transfer zone of the photoconductor drum; wherein

the photoconductor unit includes a photoconductor support means for supporting the photoconductor drum rotatably,

a pre-transfer guide plate for guiding a transfer sheet to be conveyed to the transfer zone is disposed on the photoconductor support means, and

when a pressing force by a transfer sheet is exerted at least during the guidance of the transfer sheet, the rear surface of the pre-transfer guide plate is brought into contact with a development housing constituting the developing unit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view schematically showing a printer having an embodiment of a process unit constructed in accordance with the present invention;

FIG. **2** is a sectional view of the process unit of FIG. **1** that is constructed in accordance with the present invention;

FIG. **3** shows another embodiment of a pre-transfer guide plate disposed in a photoconductor unit constituting the process unit illustrated in FIG. **2**, as a perspective view of the pre-transfer guide plate viewed from its rear surface;

FIG. **4** is an explanatory drawing showing the movement of a transfer sheet conveyed to a transfer zone in the process unit illustrated in FIG. **2**; and

FIG. **5** is an essential part sectional view of another embodiment of a deflection preventing means of the pre-transfer guide plate disposed in the photoconductor unit constituting the process unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of a process unit of an image forming machine constructed in accordance with the present invention will be described in detail with reference to the accompanying drawings. In the illustrated embodiment, a printer will be taken as an example of the image forming machine equipped with the process unit constructed in accordance with the invention.

FIG. **1** schematically shows a printer **2** on which an embodiment of the process unit constructed in accordance with the invention is mounted. In this embodiment, the printer **2** is a compact, slow-speed laser printer for use as a printer for a word processor, and has a machine housing **20** molded from a plastic material. This machine housing **20** includes an upwardly open box-shaped housing body **21**, and a cover **23** mounted turnably on a shaft **22** disposed at the top of the housing body **21**. At nearly the center of the machine housing **20** so constructed, a process unit **4** is mounted detachably.

The process unit **4**, as shown in FIG. **2**, has a photoconductor unit **40**, and a developing unit **50** pivotably supported at an upper part of the photoconductor unit **40** via a support shaft **5**. The photoconductor unit **40** has a photoconductor

support means **41**. The photoconductor support means **41** has a pair of side wall members **411** arranged with spacing in the back-and-forth direction (the direction perpendicular to the sheet face of FIG. **2**) (only the rear side wall member is shown in FIG. **2**), and a connecting member **412** which connects together lower parts of the pair of side wall members **411**. The so constructed photoconductor support means **41** is integrally molded from a plastic material. At the upper end parts, on the developing unit **50** side, of the pair of side wall members **411** constituting the photoconductor support means **41**, support portions **413** having mounting holes **414** are provided. By inserting the support shaft **5** made of a metal bar material, which is disposed in a development housing (to be described later on) of the developing unit **50**, into the mounting holes **414** provided in the support portions **413**, the photoconductor unit **40** and the developing unit **50** are supported so as to be pivotable relative to each other.

The photoconductor unit **40** has a photoconductor drum **42** having a photosensitive layer on its peripheral surface. The photoconductor drum **42** has its rotating shaft **421** rotatably supported by the pair of side wall members **411** constituting the photoconductor support means **41**, and rotationally driven by a drive means (not shown) in the direction of an arrow, i.e., from below to above in a developing zone, the site of contact (the site of nip) with a developing roller (to be described later on) of the developing unit **50**. On the connecting member **412** of the photoconductor support means **41**, a charging corona discharger **43** is disposed opposite the lower peripheral surface of the photoconductor drum **42**. Upstream from the charging corona discharger **43** in the direction of rotation of the photoconductor drum **42**, a paper dust removing brush **44** is disposed in contact with the peripheral surface of the photoconductor drum **42**.

Between the pair of side wall members **411** constituting the photoconductor support means **41**, there is disposed a lower guide plate **451** constituting one of a pair of pre-transfer guide plates **45** for guiding a transfer sheet, which is fed from upper left in FIG. **2**, in a place above the photoconductor drum **42** toward a transfer zone **422** on the peripheral surface of the photoconductor drum **42**. This lower guide plate **451** is molded integrally with the pair of side wall members **411**. On the top surface of the lower guide plate **451**, a plurality of guide ribs **451***a* are integrally molded with spacing in the longitudinal direction (the direction perpendicular to the sheet face of FIG. **2**). On the bottom (rear) surface of the lower guide plate **451**, too, a plurality of reinforcing ribs **451***b* are integrally molded with spacing in the longitudinal direction (the direction perpendicular to the sheet face of FIG. **2**). These reinforcing ribs **451***b* are adapted to contact the support shaft **5**. Thus, the lower guide plate **451** can be prevented from deflecting because of the contact of the reinforcing ribs **451***b* with the support shaft **5**, even when a pressing force acts on the top surface of the lower guide plate **451** in an attempt to cause its deflection. The reinforcing ribs **451***b* and the support shaft **5** may be in contact with each other when the process unit is assembled. However, their positions of contact are difficult to align by strict dimensional control, because of possible errors in production and assembly. Hence, there may be a design in which a tiny gap is provided between the reinforcing ribs **451***b* and the support shaft **5**, and when a pressing force of a transfer sheet being guided acts on the lower guide plate **451** to deflect it slightly, the reinforcing ribs **451***b* make contact with the support shaft **5**. Furthermore, the lower guide plate **451** is molded integrally with the pair of side wall members **411** provided with the mounting holes **414** through which the support shaft **5** is inserted. Thus, the lower guide plate **451** has no variations from product to product, and any product can ensure the contact relationship between the lower guide plate **451** and the support shaft **5**. The lower guide plate **451** can function as a connecting member for connecting together the upper parts of the pair of side wall members **411** constituting the photoconductor support means **41**, thereby improving the rigidity and strength of the photoconductor support means **41**. In the illustrated embodiment, moreover, the lower guide plate **451** is molded integrally with the pair of side wall members **411**, so that it can maintain a highly precise positional relationship with the photoconductor drum **42** supported rotatably on the pair of side wall members **411**. In addition, the lower guide plate **451** in the illustrated embodiment can function not only as a member for preventing contact with the photosensitive layer of the photoconductor drum **42** at the time of mounting or dismounting the process unit **4**, but also as a member for preventing a touch on the developing roller (to be described later on) of the developing unit **50**.

Another embodiment of the lower guide plate **451** constituting the pre-transfer guide plate pair **45** will be described with reference to FIG. **3**.

The lower guide plate **451** in the embodiment of FIG. **2** is molded integrally with the pair of side wall members **411**, while a lower guide plate **451** in an embodiment illustrated in FIG. **3** is constructed from a separate member. That is, the lower guide plate **451** has mounting flanges **451***c* at its opposite ends, and these flanges **451***c* are mounted on the pair of side wall members **411** by means of machine screws **451***d*.

Between the pair of side wall members **411** constituting the photoconductor support means **41**, a post-transfer guide plate **46** is disposed for guiding the transfer sheet, undergoing transfer in the transfer zone **422**, to a fixing means to be described later on. The post-transfer guide plate **46** is molded integrally with the pair of side wall members **411**. Thus, the post-transfer guide plate **46** can function as a connecting member for connecting together the pair of side wall members **411** constituting the photoconductor support means **41**, thereby improving the rigidity and strength of the photoconductor support means **41**. In addition, the post-transfer guide plate **46** in the illustrated embodiment can also function as a member for preventing contact with the photosensitive layer of the photoconductor drum **42** at the time of mounting or dismounting the process unit **4**.

Next, the developing unit **50** as a latent electrostatic image developing device will be described. The developing unit **50** in the illustrated embodiment has a development housing **51** accommodating a developer comprising a one-component toner. The development housing **51** is composed of a bottom wall **511**, a front side wall **512** and a rear side wall **512** (only the rear side wall is shown in FIG. **2**) erected upright from the front and rear ends of the bottom wall **511** (the ends in the direction perpendicular to the sheet face of FIG. **2**), and a left side wall **513**. These walls are integrally molded from a plastic material, defining an agitation chamber **514** and a development chamber **515**. On the bottom wall **511** constituting the development housing **51**, a partition wall **516** provided in the back-and-forth direction (the direction perpendicular to the sheet face in FIG. **2**) is integrally molded between the agitation chamber **514** and the development chamber **515**. The left and right surfaces of the partition wall **516** are formed as arcuate guide surfaces **516***a* and **516***b*. Between the front and rear side walls **512** constituting the

development housing **51**, a connecting member **517** disposed in an upper part on the development chamber **515** side is provided integrally with the front and rear side walls **512**. In the rear side wall **512** constituting the development housing **51**, a toner supply hole **518** is formed. The toner supply hole **518** is fitted with a cap **519**. In an upper end part, on the development chamber **515** side, of the so constructed development housing **51**, the support shaft **5** is disposed so as to pass through the front and rear side walls **512**. By fitting both end parts of the support shaft **5** into the mounting holes **414** provided in the support portions **413** of the pair of side wall members **411** constituting the photoconductor support means **41** of the photoconductor unit **40**, the photoconductor unit **40** and the developing unit **50** are supported so as to be pivotable relative to each other. Between a front end site of a lower end part of the photoconductor support means **41** of the photoconductor unit **40** and a rear end site of a lower end part of the development housing **51**, coiled springs **52** are interposed as spring means. These coiled springs **52** urge the photoconductor support means **41** and the development housing **51** toward each other about the support shaft **5**. The development housing **51** is open upwards and rightwards, i.e., on the photoconductor unit **40** side.

Inside the development housing **51**, a developing roller **53**, a makeup roller **54**, an agitating means **55** and a developer regulating means **56** are disposed.

The developing roller **53** is disposed in the development chamber **515** of the development housing **51**, and includes a rotating shaft **531** mounted rotatably on the front and rear side walls **512** constituting the development housing **51**, and a solid synthetic rubber roller **532** secured to the outer peripheral surface of the rotating shaft **531**. The rotating shaft **531** may be formed of a suitable metallic material such as stainless steel. The solid synthetic rubber roller **532** is composed of a relatively flexible and conductive material, e.g., conductive solid synthetic rubber such as urethane rubber. In the illustrated embodiment, the surface roughness of the peripheral surface of the solid synthetic rubber roller **532**, i.e., the 10-point average roughness Rz defined in JIS B 0601, is set at 5.0 to 12.0. The volume resistivity of the solid synthetic rubber roller **532** is set at about 10^4 to 10^9 Ω·cm. The roller hardness of the solid synthetic rubber roller **532** is set at an Asker hardness of 60 to 80 in the illustrated embodiment. The so constructed roller **532** of the developing roller **53** is exposed through the right-hand opening formed in the development housing **51**, and positioned opposite the photoconductor drum **42**. The peripheral surface of the roller **532** constituting the developing roller **53** is pressed against the peripheral surface of the photoconductor drum **42** in the developing zone. At the nip in this pressed condition, the peripheral surface of the roller **532** is compressed slightly elastically. The rotating shaft **531** of the developing roller **53** is rotationally driven by a drive means (not shown) in the direction of an arrow, i.e., from below to above in the developing zone, the site of contact between the roller **532** and the photoconductor drum **42**. In accordance with this rotation of the rotating shaft **531**, the roller **532** is also rotationally driven in the direction of the arrow, so that the peripheral surface of the roller **532** is sequentially moved through a developer holding zone **533**, a developer regulating zone **534**, and a developing zone **535**. In the illustrated embodiment, a constant voltage of 300V is applied to the rotating shaft **531** of the developing roller **53**.

The makeup roller **54** is disposed parallel to the developing roller **53** inside the development chamber **515** of the development housing **51**. The makeup roller **54** includes a rotating shaft **541** mounted rotatably on the front and rear side walls **512** constituting the development housing **51**, and a roller **542** secured to the outer peripheral surface of the rotating shaft **541**. The rotating shaft **541**, like the rotating shaft **531** of the developing roller **53**, may be formed of a suitable metallic material, such as stainless steel. The roller **542** is composed of a foam such as silicone foam or urethane foam. The roller **542** is pressed against the roller **532** of the developing roller **53** in the developer holding zone **533**, the nip between the roller **542** and the developing roller **53**. The hardness of the foam constituting the roller **542** of the makeup roller **54** is much smaller than the hardness of the roller **532** constituting the developing roller **53** (for example, an Asker hardness of about 35), and it is desirable that by being pressed against the roller **532** of the developing roller **53**, the roller **542** be elastically compressed in the nip region by about 0.1 to 0.6 mm. The roller **542** also has conductivity, and its volume resistivity is set at about 10^2 to 10^6 Ω·m. The rotating shaft **541** of the developing roller **54** is rotationally driven by a drive means (not shown) in the direction of an arrow, i.e., from above to below in the developer holding zone **533**, the nip between the roller **542** and the roller **532** of the developing roller **53**. In accordance with this rotation of the rotating shaft **541**, the roller **542** is also rotationally driven in the direction of the arrow. In the illustrated embodiment, a constant voltage of 450V, a higher voltage than the voltage applied to the developing roller **53**, is applied to the rotating shaft **541** of the makeup roller **54**.

The peripheral speed V1 of the photoconductor drum **42**, the peripheral speed V2 of the developing roller **53**, and the peripheral speed V3 of the makeup roller **54** are set in the relationship $V1<V2<V3$. In the illustrated embodiment, the relation between the peripheral speed V1 of the photoconductor drum **42** and the peripheral speed V2 of the developing roller **53** is set to be $1.2V1 \leqq V2 \leqq 2.5V1$, while the relation between the peripheral speed V2 of the developing roller **53** and the peripheral speed V3 of the makeup roller **54** is set to be $1.0V2 \leqq V3 \leqq 2.0V2$. If the peripheral speed V2 of the developing roller **53** is less than 1.2V1, the supply of a developer to the photoconductor drum **42** will be insufficient, and the density of an image may lower. If the peripheral speed V2 of the developing roller **53** is less than 1.2V1, moreover, there will be a decline in the scraping action of the developing roller **53** on the non-transferred developer that adheres to the photoconductor drum **42** after transfer. Thus, the non-transferred developer cannot be removed from the photoconductor drum **42**, potentially causing a so-called offset fog. If the peripheral speed V2 of the developing roller **53** is more than 2.5V1, on the other hand, the drive torque of the developing roller **53** will increase, possibly causing a scatter of the developer by a centrifugal force. Besides, if the peripheral speed V3 of the makeup roller **54** is less than 1.0V2, the supply of a developer to the developing roller **53** will be insufficient, and image density may lower. If the peripheral speed V3 of the makeup roller **54** is less than 1.0V2, moreover, there will be a weak scraping action of the makeup roller **54** on the peripheral surface of the developing roller **53**. In case the non-transferred developer adhering to the photoconductor drum **42** after transfer adheres to the developing roller **53**, therefore, this adherent developer will be difficult to remove. The adherent developer may generate a ghost in a subsequent development. If the peripheral speed V3 of the makeup roller **54** is more than 2.0V2, on the other hand, the drive torque of the makeup roller **54** will increase. Simultaneously, the developer will strongly tend to rest above the nip between the makeup roller **54** and the devel-

oping roller **53**, possibly causing an insufficient supply of the developer to the developing roller **53**.

In the agitation chamber **514** of the development housing **51**, an agitating means **55** is disposed. The agitating means **55** is disposed parallel to the makeup roller **54**, and includes a rotating shaft **551** mounted rotatably on the front and rear side walls **512** constituting the development housing **51**, an agitating member **552** fixed to the rotating shaft **551**, and an elastic agitating sheet member **553** mounted to the agitating member **552**. The agitating member **552** is formed of a plastic material, and has a plurality of openings in the longitudinal direction (the direction perpendicular to the sheet face of FIG. **2**). The agitating sheet member **553** is formed of a flexible, elastic material, such as polyethylene terephthalate (PETP), and is secured by an adhesive or the like to the front edge of the agitating member **552**. The so constructed agitating means **55** is rotationally driven continuously by a drive means (not shown) in the direction of an arrow in FIG. **2**.

The developer regulating means **56** has a flexible, elastic blade **561** to be pressed against the peripheral surface of the roller **532** constituting the developing roller **53**. The blade **561** is composed of, say, a stainless steel plate or a spring steel plate about 0.1 to 0.2 mm thick, and has nearly the same longitudinal dimension as the length of the roller **532** constituting the developing roller **53**. The blade **561** has a base end part mounted on a blade mounting portion **511***a* provided at the open end, on the photoconductor unit **40** side, of the bottom wall **511** constituting the development housing **51**. That is, the base end part of the blade **561** is sandwiched between the blade mounting portion **511***a* and a press plate **562**, and is fixed thereto by means of a machine screw **563**. A front end part of the blade **561** is bent, and this bend is pressed against the peripheral surface of the roller **532** constituting the developing roller **53** in the developer regulating zone **534**.

On the development housing **51**, a closure **57** is mounted which covers the open top of the development housing **51** and constitutes part of the development housing **51**. The closure **57** is composed of a plastic material, and is secured by an adhesive to the top surfaces of the front and rear side walls **512**, the left side wall **513** and the connecting member **517** that constitute the development housing **51**. On the inner surface of the closure **57**, a regulating portion **571** is integrally molded which extends in the back-and-forth direction (the direction perpendicular to the sheet face of FIG. **2**) at a position opposite the makeup roller **54**, and which protrudes on the development chamber **515** side. Between the lower end of the regulating portion **571** and the outer peripheral surface of the roller **542** constituting the makeup roller **54**, a predetermined spacing is provided. In the illustrated embodiment, the connecting member **517** constituting the development housing **51** is mounted with a sheet-like seal member **58**. The sheet-like seal member **58** is composed of a flexible, elastic sheet member of, say, polyethylene terephthalate (PETP), and has nearly the same length as the axial length of the roller **532** constituting the developing roller **53**. The sheet-like seal member **58** has one end part secured to the connecting member **517** by a securing means such as an adhesive, and has the other end part curved and elastically contacted with the peripheral surface of the roller **532** constituting the developing roller **53**. The so constructed sheet-like seal member **58** prevents a scatter of the developer from the opening, on the photoconductor unit **40** side, of the development housing **51** in cooperation with the blade **561** of the developer regulating means **56**.

The so constructed process unit **4** is mounted detachably on the machine housing **20** of the printer **2**, as shown in FIG. **1**. That is, the cover **23** constituting the machine housing **20** of the printer **2** is turned about the shaft **22** counterclockwise in FIG. **1**, whereby the top of the housing body **21** constituting the machine housing **20** is opened. Then, the process unit **4** is mounted inside the housing body **21** from above. Inside the housing body **21**, a positioning means (not shown) capable of placing the photoconductor unit **40** of the process unit **4** at a predetermined position is provided. After the process unit **4** is mounted inside the housing body **21** of the machine housing **20**, the cover **22** is turned about the shaft **22** clockwise in FIG. **1** to close the top of the housing body **21**.

As shown in FIG. **1**, a laser unit **24** is disposed in a lower part of the housing body **21** constituting the machine housing **20** of the printer **2**. This laser unit **24** throws laser light, corresponding to print data from, say, a word processor connected to the printer **2**, upon the photosensitive layer of the photoconductor drum **42** in an exposure zone **423** of the process unit **4**, thereby forming a latent electrostatic image. In the housing body **21** constituting the machine housing **20** of the printer **2**, a fixing roller pair **25** is disposed downstream from the post-transfer guide plate **46**. Downstream from the fixing roller pair **25**, a discharge roller pair **26** is disposed. Furthermore, a copy receiving or discharge tray **27** is disposed downstream from the discharge roller pair **26**.

On the cover **23** constituting the machine housing **20** of the printer **2**, a feed tray **28** for bearing a transfer sheet is disposed at an upper left part in FIG. **2**. Downstream from the feed tray **28**, a feed roller **29** is disposed. This feed roller **29** is rotationally driven by a drive means (not shown) in the direction of an arrow in FIG. **2**. Opposite the feed roller **29**, a friction pad **30** for sheet separation is disposed. In the transfer zone **422**, a non-contact transfer roller **31** is disposed opposite the photoconductor drum **42**. The transfer roller **31** is formed of a conductive urethane foam, and rotatably supported on the cover **23**. The transfer roller **31** has opposite end parts mounted with collars (not shown) which are composed of an insulating material, such as synthetic resin, and each of which has a larger outside diameter than the diameter of the transfer roller **31**. These collars are disposed in contact with the peripheral surface of the photoconductor drum **42**. Thus, the transfer roller **31** is caused to follow the rotation of the photoconductor drum **42** while slipping. The clearance between the peripheral surface of the transfer roller **31** and the peripheral surface of the photoconductor drum **42** is set at about 0.5 mm. A constant voltage of, say, 10 μA is applied to the so constructed transfer roller **31**. On the cover **23**, an upper guide plate **452** constituting the other component of the pre-transfer guide plate pair **45** is disposed.

The printer **2** in the illustrated embodiment is constructed as described above. Its actions will be described with reference to FIG. **4** as well.

Based on a print command from a word processor or the like (not shown), the above-described members start operation, and the photosensitive layer on the surface of the photoconductor drum **42** is charged substantially uniformly to a specific polarity by the charging corona discharger **43**. Then, the laser unit **24** throws laser light, corresponding to the print data from the word processor or the like, upon the surface of the charged photosensitive layer of the photoconductor drum **42**, thereby forming a latent electrostatic image there. The latent electrostatic image formed on the photosensitive layer of the photoconductor drum **42** is developed to a toner image by the developing action of the developing

unit **50**. The developing action of the developing unit **50** will be described in detail later on. Transfer sheets laid on the feed tray **28** are fed one by one by the action of the feed roller **29** and the friction pad **30**. The fed transfer sheet is guided by the pre-transfer guide plate pair **45**, and conveyed to the transfer zone **422** where the photoconductor drum **42** and the transfer roller **31** are opposite to each other. Thus, the toner image formed on the photoconductor drum **42** is transferred to the surface of the transfer sheet. FIG. **4** shows a state immediately after the front end of the transfer sheet P, fed by the feed roller **29**, contacts the photoconductor drum **42**. In detail, the transfer sheet P fed by the feed roller **29** has its front end guided by the upper guide plate **452** of the pre-transfer guide plate pair **45**, and brought into contact with the photoconductor drum **42**. At this time, as indicated by a broken line in FIG. **4**, its front end part is curved toward the lower guide plate **451**, and this curvature presses the lower guide plate **451**. The transfer sheet P with a strong nerve, such as a postcard, exerts a great pressing force when curved. This pressing action tends to deflect the lower guide plate **451**, but the reinforcing ribs **451***b* provided on the rear surface of the lower guide plate **451** contact the support shaft **5**, preventing the deflection of the lower guide plate **451**. This in turn prevents defective conveyance of the transfer sheet P to the transfer zone **422** due to the deflection of the pre-transfer guide plate.

The transfer sheet, conveyed to the transfer zone **422** and having the toner image transferred thereto, is guided by the post-transfer guide plate **46** to be carried to the fixing roller pair **25**. The transfer sheet having the toner image heat-fixed by the fixing roller pair **25** is discharged onto the discharge tray **27** by the discharge roller pair **26**. In the illustrated embodiment, the lower guide plate **451**, one of the constituents of the pre-transfer guide plate pair **45** for guiding the transfer sheet toward the transfer zone **422** on the peripheral surface of the photoconductor drum **42**, is molded integrally with the pair of side wall members **411** that support the photoconductor drum **42** rotatably. Thus, the lower guide plate **451** can maintain a highly precise positional relationship with the photoconductor drum **42**. Consequently, the lower guide plate **451** has no variations from product to product, and any product would permit a transfer sheet to be conveyed reliably to a predetermined position in the transfer zone **422**.

The developing action of the developing unit **50** will be described.

After the start of operation of the developing unit **50**, the developing roller **53**, makeup roller **54** and agitating means **55** are rotationally driven by drive means (not shown) in the directions of the arrows. In accordance with the rotation of the agitating member **552** and agitating sheet member **553**, constituting the agitating means **55**, in the direction of the arrow, the developer accommodated in the agitation chamber **514** is passed over the partition wall **516** while being agitated, whereafter the developer is fed into the development chamber **515** from above the makeup roller **54**. On this occasion, the amount of the developer fed into the development chamber **515** is controlled by the regulating portion **571** formed on the inner surface of the closure **57** so that this amount will not be excessive. The developer so supplied by the agitating means **55** is borne on the roller **542** of the makeup roller **54**, and carried to the nip between the roller **542** and the roller **532** of the developing roller **53**, which is also the developer holding zone **533**. The makeup roller **54** and the developing roller **53**, as described above, rotate in the developer holding zone **533**, the nip, in the same direction, from above to below. Thus, the supply of the developer from the makeup roller **54** to the developing roller **53** is adequate, preventing lack of the developer. Since the makeup roller **54** and the developing roller **53**, as described above, rotate in the same direction in the developer holding zone **533**, the nip, moreover, they can be driven reliably without requiring a great drive force.

The developer sent to the developer holding zone **533**, the nip between the makeup roller **54** and the developing roller **53**, is conveyed toward the developer regulating zone **534** while being held on the peripheral surface of the roller **532** constituting the developing roller **53**. At this time, the makeup roller **54** and the developing roller **53** rotate in the same direction, from above to below, in the developer holding zone **533**, the nip, as described earlier. The developer also passes through the nip, remains held on the developing roller **53**, and moves to the developer regulating zone **534** and the developing zone **535**. When passing through the nip, the developer is fully rubbed against the makeup roller **54** and the developing roller **53** and fully charged, thus preventing the occurrence of a fog.

In the developer regulating zone **534**, the blade **561** of the developer regulating means **56** acts on the developer held on the peripheral surface of the roller **532** of the developing roller **53** to restrict the developer held on the peripheral surface of the roller **532** to a required amount and form it into a thin layer. The developer, which has been regulated by the blade **561** of the developer regulating means **56** in the developer regulating zone **534** and scraped off onto the bottom wall **511** of the development housing **51**, does not remain stationary, but is conveyed along the guide surface **516***b* of the partition wall **516**, because the makeup roller **54** is rotated in the direction of the arrow.

As described above, the developer is held on the peripheral surface of the roller **532** constituting the developing roller **53** in the developer holding zone **533**, and formed into a thin layer by the action of the blade **561** of the developer regulating means **56** in the developer regulating zone **534**. Then, this developer is conveyed to the developing zone **535** in accordance with the rotation in the direction of the arrow.

In the developing zone **535**, the developer is applied to the latent electrostatic image on the electrostatic photoconductor disposed on the peripheral surface of the photoconductor drum **42**, whereby the latent electrostatic image is developed to a toner image. For example, the latent electrostatic image has a non-image area charged to about +600V, and an image area charged to about +120V, and a toner as the developer is caused to adhere to the image area (reversal development). The photoconductor drum **42** and the developing roller **53** are rotationally driven in the directions of the arrows in FIG. **2**. In the developing zone **535**, therefore, the peripheral surface of the photoconductor drum **42** and the peripheral surface of the roller **532** constituting the developing roller **53** are both moved in the same direction, from below to above. Since the peripheral speed V2 of the roller **532** and the peripheral speed V1 of the photoconductor drum **42** are set in the relationship 1.2V1(V2(2.5V1, a sufficient amount of the developer is carried to the developing zone **535** by the roller **532** of the developing roller **53**. Also, the rubbing action of the peripheral surface of the roller **532** on the peripheral surface of the photoconductor drum **42** properly peels off the developer that has once adhered to the non-image area of the latent electrostatic image. Hence, a satisfactory image having an appropriate development density and free from fog can be obtained. The developer after use that has passed through the developing zone **535** while being held on the peripheral surface of the roller **532** constituting the developing roller **53**, on the other hand, is passed on to

the surface of the makeup roller **54** at the nip between the developing roller **53** and the makeup roller **54**. The peripheral speed of the makeup roller **54** is set to be greater than the peripheral speed of the developing roller **53**. Therefore, as the developer is shifted to the makeup roller **54** at the nip, the non-transferred developer adhering to the developing roller **53** during passage through the developing zone **535** cab be decreased in adherence, and recovered. Hence, a ghost ascribed to the non-transferred developer adhering to the developing roller **53** can be prevented.

FIG. **5** shows another embodiment of the deflection preventing means for the lower guide plate **451** constituting the pre-transfer guide plate pair **45**. In FIG. **5**, the same members as the members in the embodiment of FIG. **2** are assigned the same numerals, and a detailed explanation for them will be omitted.

In this embodiment, the closure **57** constituting part of the development housing is formed to extend to a position opposite the rear surface of the lower guide plate **451**. At its front end, a support portion **572** to be contacted by the reinforcing ribs **451***b* provided on the rear surface of the lower guide plate **451** is integrally molded. Thus, the lower guide plate **451** may be deflected by the action of the pressing force due to the curvature of the transfer sheet P, as has been described previously. However, the reinforcing ribs **451***b* provided on the rear surface of the lower guide plate **451** make contact with the support portion **572**, preventing the deflection of the lower guide plate **451**. In the illustrated embodiment, the aforementioned sheet-like seal member **58** is mounted on the front end of the support portion **572** by means of an adhesive.

The process unit according to the present invention has been described based on the embodiments in which it is applied to a printer. However, the present invention is in no way limited to the illustrated embodiments. The invention is applicable, for instance, to an electrostatic copier, and various changes or modifications are possible without departing from the scope of the technical concept of the invention.

Since the process unit according to the present invention is constructed as described above, it exhibits the following actions and effects:

The present invention is a process unit of an image forming machine, the process unit comprising a photoconductor unit including a photoconductor drum, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image, the photoconductor unit and the developing unit being connected by a support shaft so as to be pivotable relative to each other; in which a pre-transfer guide plate for guiding a transfer sheet to be conveyed to a transfer zone is disposed on a photoconductor support means for supporting the photoconductor drum rotatably, and when a pressing force by a transfer sheet is exerted at least during the guidance of the transfer sheet, the rear surface of the pre-transfer guide plate is brought into contact with the support shaft. Thus, the pre-transfer guide plate may be deflected under the pressing action due to the curvature of the transfer sheet during its conveyance to the transfer zone; however, the rear surface of the pre-transfer guide plate contacts the support shaft, preventing its deflection. This in turn prevents defective conveyance of a transfer sheet to the transfer zone due to the deflection of the pre-transfer guide plate during transport of the transfer sheet. Furthermore, the pre-transfer guide plate contacts the support shaft, thus avoiding the situation that the pre-transfer guide plate provided in the photoconductor unit contacts the photoconductor drum or the developing unit to affect the pressing force working between the photoconductor drum and the developing unit. This makes it possible to prevent the occurrence of a defective image owing to a change in the pressing force.

The present invention is also a process unit of an image forming machine, the process unit comprising a photoconductor unit including a photoconductor drum, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image; wherein a pre-transfer guide plate for guiding a transfer sheet to be conveyed to a transfer zone is disposed on a photoconductor support means for supporting the photoconductor drum rotatably, and when a pressing force by a transfer sheet is exerted at least during the guidance of the transfer sheet, the rear surface of the pre-transfer guide plate is brought into contact with a development housing constituting the developing unit. Thus, the pre-transfer guide plate may be deflected under the pressing action due to the curvature of the transfer sheet during its conveyance to the transfer zone; however, the rear surface of the pre-transfer guide plate contacts the development housing, preventing the deflection of the pre-transfer guide plate. This in turn prevents defective conveyance of a transfer sheet to the transfer zone due to the deflection of the pre-transfer guide plate during transport of the transfer sheet.

In addition, the pre-transfer guide plate is molded integrally with the pair of side wall members constituting the photoconductor support means. Thus, the pre-transfer guide plate serves as a connecting member which connects together the upper parts of the pair of side wall members, so that the rigidity and strength of the photoconductor support means can be increased. Furthermore, the pre-transfer guide plate is molded integrally with the pair of side wall members having the mounting holes through which the support shaft is inserted. Accordingly, the pre-transfer guide plate has no variations from product to product, and any product can ensure the contact relationship between the pre-transfer guide plate and the support shaft.

What we claim is:

1. A process unit of an image forming machine, said process unit comprising a photoconductor unit including a photoconductor drum having a photosensitive layer, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image, said photoconductor unit and said developing unit being connected by a support shaft so as to be pivotable relative to each other, and said process unit being adapted to transfer the toner image to a transfer sheet conveyed to a transfer zone of the photoconductor drum; wherein

said photoconductor unit includes photoconductor support means for supporting the photoconductor drum rotatably,

a pre-transfer guide plate for guiding a transfer sheet to be conveyed to the transfer zone is disposed on the photoconductor support means, and

when a pressing force by a transfer sheet is exerted at least during the guidance of the transfer sheet, the rear surface of the pre-transfer guide plate is brought into contact with the support shaft.

2. A process unit of an image forming machine as claimed in claim **1**, wherein a plurality of reinforcing ribs are provided on the rear surface of the pre-transfer guide plate with spacing in the longitudinal direction, and said reinforcing ribs are brought into contact with the support shaft.

3. A process unit of an image forming machine as claimed in claim **1**, wherein said photoconductor support means has

a pair of side wall members for rotatably supporting opposite end parts of the photoconductor drum, said pair of side wall members are provided with holes through which the support shaft is inserted, and said pre-transfer guide plate is molded integrally with said pair of side wall members.

4. A process unit of an image forming machine, said process unit comprising a photoconductor unit including a photoconductor drum having a photosensitive layer, and a developing unit for developing a latent electrostatic image formed on the photosensitive layer of the photoconductor drum to a toner image, and said process unit being adapted to transfer the toner image to a transfer sheet conveyed to a transfer zone of the photoconductor drum; wherein

said photoconductor unit includes photoconductor support means for supporting the photoconductor drum rotatably,

a pre-transfer guide plate for guiding a transfer sheet to be conveyed to the transfer zone is disposed on the photoconductor support means, and

when a pressing force by a transfer sheet is exerted at least during the guidance of the transfer sheet, the rear surface of said pre-transfer guide plate is brought into contact with a development housing constituting said developing unit.

5. A process unit of an image forming machine as claimed in claim 1, wherein a plurality of reinforcing ribs are provided on the rear surface of the pre-transfer guide plate with spacing in the longitudinal direction, and said reinforcing ribs are brought into contact with the development housing.

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